Original Research Article

Ropivacaine 0.2% And Lignocaine 0.5% in Intravenous Regional Anaesthesia

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Abstract

Introduction- Ropivacaine has been compared with lignocaine for intravenous regional anesthesia (IVRA). Aim of this study were to evaluate the anesthetic efficacy, post block residual analgesia, and any toxicity of two local anesthetics (LA) agents-ropivacaine and lignocaine. **Materials and Methods:** Sixty patients with American Society of Anesthesiologists physical status I or II who were scheduled to undergo forearm and hand surgery were randomly allocated to administration of 40 ml of either 0.2% ropivacaine or 0.5% lignocaine for IVRA. Onset and regression of sensory and motor block were assessed by response to pinprick and by testing hand movements, respectively. Visual analog scores (VAS) were assessed intraoperatively and postoperatively. **Results:** Adequate surgical anesthesia was provided with both ropivacaine and lignocaine. The mean sensory block onset and regression times were significantly delayed with ropivacaine as compared to lignocaine ($P < 0.05$). Postoperatively, the VAS was significantly lower in ropivacaine group in the first 90 min. Time to the first analgesic drug in the postoperative period was significantly longer in ropivacaine group (44 ± 11.04 min) as compared to lignocaine group (28 ± 9.32 min). None of the patients in any group showed any evidence of local anesthetic toxicity. **Conclusions:** IVRA for upper limb surgery using 0.2% ropivacaine is a better option as compared to 0.5% lignocaine as it provides longer postoperative analgesia.

Keywords: Intravenous regional anesthesia, lignocaine, ropivacaine

Introduction

One of the classical techniques of regional anesthesia is intravenous regional anesthesia (IVRA) also called as Bier's block. This simple technique requires only minimal equipment, that is, a tourniquet to temporarily occlude arterial circulation in a limb after exsanguination. Local anesthetic (LA) is then injected into the distal venous system, leading to the rapid onset of anesthesia in the occluded limb and surgery is made possible. After the completion of surgery, when the tourniquet is released, there is a rapid return of normal sensation and motor power.IVRA is a safe and reliable technique for providing anesthesia as well as a bloodless field during limb surgery.[1] In this era of day care surgery, the rapid induction-recovery time and minimum hospital stay makes IVRA a useful and cost effective method of anesthesia. It is also a popular choice in trauma and emergency services as a large number of cases are those of fractures and limb injuries and may be sub-optimally prepared for general anesthesia.The ideal drug for IVRA anesthetic solution should have a rapid onset, require less dose of LA, reduce tourniquet pain, and prolong postdeflation analgesia. Lignocaine, first used by Holmes[2] for IVRA in 1963, is the most popular LA choice for IVRA worldwide. The potential complication which can occur with IVRA technique is LA toxicity, which results from sudden release of large amounts of LA into the systemic circulation if thetourniquet deflates accidently during the procedure or if it is deflated fast at the end of the procedure.[3] Various methods have been used to prevent this systemic toxicity, the most certain of them is to limit the amount of drug used. However, the volume of drug required to achieve surgical anesthesia depends on the estimated volume of the venous system in the isolated limb. Dose reduction can be achieved by using a diluted solution. Lignocaine is the most frequently used LA for IVRA in North America as it is an agent which is considered less cardiotoxic and neurotoxic than the others.[4] It has, however, a relatively brief duration of action, which limits the postoperative analgesia that can be provided. The use of a longer-acting agent may offer an improvement. Bupivacaine, a long-acting agent used in the past, is no longer recommended for IVRA because of its risk of causing irreversible cardiac arrest.[5,6] Prilocaine is another popular drug for IVRA and is the most commonly used agent in Europe.[7] It has a relatively short duration of action and is the least toxic of the amino-amide local anesthetics.[8] However, at higher concentrations, the risk of CNS toxicity increases.[9,10] This agent is, however, not available in India. Ropivacaine, a newer LA, is a pure levorotatory enantiomer of Bupivacaine and causes less depression of cardiac conduction.[11-13] Its use has increased in popularity because of its potential to offer prolonged and improved analgesia as compared to lignocaine, with a lower toxicity profile than bupivacaine.[14] Although ropivacaine has been extensively studied for central neuraxial blocks, there are only few studies for use in IVRA. We have conducted this study to evaluate the efficacy and safety of this technique of IVRA using ropivacaine and comparing with the traditional agent lignocaine.

Method

The study protocol was approved by the Institutional Ethics Committee. After written informed consent, 60 patients of either sex in the age group of 15–60 years with American Society of Anesthesiologists I or II classification scheduled for upper limb surgery were enrolled in the study. Those who had any history of

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allergy to LA drug or those patients in which the anticipated surgery duration was more than 1 h were excluded from the study. All patients fasted overnight or for a minimum of 6 h. The patients were explained about the visual analog scoring (VAS) preoperatively. They were premedicated with alprazolam tablet 0.25 mg 2 h before surgery. The patients were randomly allotted in two groups of 30 each using closed envelope technique. Group A patients were given lignocaine and Group B patients were given ropivacaine as the test drug.Routine monitoring (electrocardiogram, SpO2 , and NIBP) was performed throughout the procedure. Intravenous (IV) cannulation with an 18-Gauge cannula in the nonoperative limb was done. After testing the tourniquet equipment for any leaks, two pneumatic tourniquets were placed on the upper arm of the operative limb. A 22-Gauge cannula was secured on the dorsum of hand near the operative site. Limb exsanguination was achieved by Esmarch bandage or after limb elevation at 90° for 3 min. The proximal tourniquet was inflated to a pressure of 100 mmHg above the patient's systolic blood pressure and to a maximum of 250 mmHg. Circulatory isolation of the operative arm was confirmed by limb oligemia, the absence of radial and ulnar pulses, and loss of pulse oximeter tracing. The concentrations of the lignocaine and ropivacaine used were 0.5% and 0.2%, respectively, and the volume of the anesthetic drug was 40 ml in both the groups. The drug was administered slowly over a period of 3 min through the previously secured 22-Gauge cannula. After injecting the drug, the onset of sensory block was assessed at 1-min intervals by the response to a pinprick. The tests were carried out in four areas: In the sensory distribution of ulnar nerve (dorsum of distal phalanx of the little finger), the radial nerve (dorsum of proximal phalanx of the thumb), the median nerve (dorsum of distal phalanx of the middle finger), and the musculocutaneous nerve (lateral area of frontal forearm). The onset time of sensory anesthesia was recorded as a time to loss of pinprick sensation. Onset time of motor block was assessed and recorded by testing the hand movements. The degree of sensory block achieved intra-operatively was assessed using an integer VAS between 0 and 100. Supplemental analgesia with IV fentanyl (1 μg/kg) was given when VAS ≥50. Subjective tourniquet discomfort was assessed at 5-min intervals after inflation of the tourniquet. When the proximal tourniquet pressure became unbearably painful, the distal cuff was inflated followed by the release of proximal cuff. The duration for which the patient tolerated the proximal tourniquet was noted in both the groups. At the end of surgery, the distal tourniquet was slowly deflated and the sensory regression of block was tested at 1-min intervals. The duration of surgery, total tourniquet time, and time for sensory regression were noted in all the patients. Postoperative pain was assessed at 5, 15, 30, 45, 60, 75, 90 min after tourniquet deflation using VAS. Time elapsedfrom tourniquet deflation to the point when VAS was ≥50 was considered to be the duration of residual analgesia. When the VAS was ≥50, the first postoperative analgesia was given using intramuscular diclofenac sodium 1.5 mg/kg and time was recorded. Patients were monitored for symptoms and signs of LA toxicity throughout the operative procedure and for 1 h after deflation of the tourniquet. The signs and symptoms which were sought were perioral tinglings, transient dizziness, tinnitus, visual disturbances, convulsions/coma, bradycardia, hypotension, and dysrhythmias. Local complications were looked for after the removal of a tourniquet.

Results

All patients enrolled in the study completed the investigation successfully. The two patient groups were comparable with respect to age, weight, and height. Mean surgical duration (mean ± standard deviation) was 90.17±18.684 and 86.67±23.829min for lignocaine and ropivacaine, respectively (P value is not significant, P = NS). The mean sensory block onset time was significantly delayed in ropivacaine (5.33 ± 1.11 min) as compared to lignocaine (4.56 ± 0.90 min)(P<0.005).The mean motor block onset time was also significantly delayed in ropivacaine (11.33 ± 0.98 min) as compared to lignocaine (10.56 ± 0.76 min) (P = 0.001). Intraoperatively, the intensity of sensory and motor block was almost similar in both the groups as assessed by VAS integer and was not statistically significant (P > 0.05). After tourniquet deflation, the mean sensory block regression time was significantly prolonged in ropivacaine (9.43 ± 0.98 min) as compared to lignocaine(6.76 ± 1.87)(P = 0.001). Also, the mean motor block regression time was significantly delayed in ropivacaine (9.11 ± 1.33) as compared to lignocaine (6.89 ± 1.76) (P =0.001) [Table 1].

Table 1: Mean Sensory Block Regression and Motor Block Regression Time

	Group R (mean ± SD)	Group L(mean ± SD)	P value
Sensory onset time (min)	5.33 ± 1.11	4.56 ± 0.90	0.001
Sensory motor time (min)	11.33 ± 0.98	10.56 ± 0.76	0.001
Mean sensory regression time (min)	9.43 ± 0.98	6.76 ± 1.87	0.001
Mean motor regression time (min)	9.11 ± 1.33	6.89 ± 1.76	0.001

Postoperatively, the median visual analog scale score was significantly lower in ropivacaine group as compared to lignocaine group (P < 0.05). The time to the first analgesic dose was significantly earlier in lignocaine group (28 ± 9.32 min) as compared to ropivacaine group (44 ± 11.04 min) (P <0.05)There was no evidence of LA toxicity in any group. There were also no complications due to the tourniquet such as bruises, cellulitis, and blisters. Postoperatively, none of the patients had any neurological symptoms in the operated limb.

Discussion

Ropivacaine, a pure S(-) enantiomer and structurally related to bupivacaine, is a long acting amide LA agent. The S-enantiomers have been shown to substantially reduce systemic toxicity when compared to their racemic counterparts. In our study, we used 0.2% ropivacaine as it has a potencyof three times of lignocaine and is commercially available in this strength. Other workers have previously used 0.2–0.375% in volunteer and patient studies.[14-18] Ropivacaine has the analgesic potency of 0.6 times relative to bupivacaine.[19] Clinically adequate dose of ropivacaine is associated with lower incidence of the motor block than bupivacaine as well as reduced potential for CNS toxicity and cardio toxicity. When used for IVRA, ropivacaine is an agent with a better safety profile than bupivacaine.[15] In our study, the onset times for sensory and motor blockade with lignocaine were faster than ropivacaine and were statistically significant, although clinically not much different. Other authors who have studied onset times include Hartmannsgruber et al. [14] who did a comparison of ropivacaine 0.2% and lignocaine 0.5% for IVRA in volunteers. They found no significant differences for onset times of anesthesia. Atanassoff et al. [15] studied the times from injection of LA to surgical incison and found that it was longer for ropivacaine (15 ± 4 min) than for lignocaine(12±4 min),which,however, was not statistically significant. Peng et al. [16] found that onset time of anesthesia (8.0 ± 4.1 min vs. 6.5 ± 2.9 min for ropivacaine and lignocaine groups, respectively) and motor block were similar in forearm IVRA. In our study, the quality of anesthesia or intraoperative degree of pain relief was almost same in both the ropivacaine and lignocainegroups. The difference in VAS scores between the two groups in the intraoperative period was not statistically significant. The two groups were comparable and there was no significant difference in the quality of anesthesia between the groups. Similar results were found

by Atanassoff et al. [15] They showed that IVRA with 0.2% ropivacaine provides anesthesia of the same surgical quality when compared with 0.5% lidocaine. At the end of surgery, after deflation of the tourniquet, we checked the sensory block by pin-prick method in the distribution of the nerves. We observed that sensory regression in both the groups showed statistically significant difference with Lignocaine group having earlier mean sensory regression after deflation of tourniquet as compared to ropivacaine group. We observed that motor regression in both the groups also showed statistically significant difference with group lignocaine having earlier meant motor regression after deflation of tourniquet as compared to group ropivacaine. Our results were similar to those of Chan et al. [17] They found that sensory recovery in the high-dose ropivacaine group (1.8 mg/kg) was significantly longer than the low-dose ropivacaine (1.2 mg/kg) or lignocaine group (3 mg/kg). In motor recovery, they had similar findings with the high-dose ropivacaine group (1.8 mg/kg), where decreased grip strength was found to be sustained for 70min as compared to complete recovery in the lignocaine group during the same period. Hartmannsgruber et al. [14] also had similar results. They observed that sensory recovery was prolonged by up to 30 min in those who received 0.2% ropivacaine as compared to 0.5% lignocaine. In motor block regression, they found that 0.2% ropivacaine resulted in decreased grip strength for up to 30 min in comparison to 0.5%. The difference in the sensory regression and motor regression between ropivacaine and lignocaine was statistically significant. Atanassoff et al. [15] also found a prolonged sensory recovery by approximately 19 min, on average, with the use of ropivacaine as compared to lignocaine. The difference in the sensory regression in between ropivacaine and lignocaine was statistically significant. Asik et al. [18] also found sensory recovery to be significantly prolonged in both 0.2% and 0.25% ropivacaine groups as compared to 0.5% lignocaine (20.5 ± 4.6 min and 23.5 ± 4.8 min as compared to 3.5 ± 1 min). In present study, we found that the median visual analog scores every 15 min for the first 90 min after the surgery were significantly lower in group ropivacaine as compared to the group lignocaine ($P < 0.05$) for each point of time. Time to the first analgesic dose after tourniquet deflation was significantly higher in group ropivacaine as compared to group lignocaine after surgery. Our results were similar to the study of Atanassof et al. [15] who found significantly lower numerical pain scores at the time of postanesthesia care unit admission and a significantly longer time to the first analgesic in those receiving 0.2% ropivacaine (median, 47 min; range, 27–340 min) as compared to 0.5% lignocaine (median, 34 min; range, 2–140 min). Peng et al. [16] also found that 0.375% ropivacaine provides superior postoperative analgesia when comparedwith 0.5% lidocaine when forearm IVRA is used. They found that verbal pain rating scores (VPRS) was significantly lower in the ropivacaine group in the first 60 min with significantly more patients in the ropivacaine group pain free (VPRS, 0) up to the first 90 min. More patients in the lignocaine group requested analgesic in the first 2 h postblock, and only patients in the lignocaine group required supplemental IV morphine in the recovery room.Asik et al. [18] also found significantly lower verbal numerical pain scores and longer time to the first analgesia in the 0.25% and 0.20% ropivacaine subjects as compared to 0.5% lignocaine (29.8 ± 4.9 min, 27.5 ± 7.3 min vs. 11.3 ± 3.9 min).No signs and symptoms of central nervous system toxicity were observed in any group in our study. However, some authors have noticed some side effects when using the two agents. In volunteer patient studies, Hartmannsgruber et al. [14] and Chan et al. [17] both demonstrated an increased incidence of temporary dizziness, tinnitus, and light-headedness in the lignocaine groups as compared to the ropivacaine group; however, these patients were not administered any sedation prior to or during the procedure. Asik et al. [18] identified an increased incidence of light-headedness, tinnitus, and metallic taste in patients receiving lignocaine as compared to ropivacaine. Niemi et al. [7] identified one patient with postoperative dizziness and blurry vision after receiving 0.5% prilocaine while none in the ropivacaine group.

Conclusion

In this study, both lignocaine and ropivacaine were found to be equally effective and safe intraoperatively while ropivacaine has the advantage of providing a slower sensory regression. This provides the surgeon extra time for hemostasis and closure of the incision. There is longer postoperative analgesia with ropivacaine, thus allowing adequate time for the action of intramuscular analgesic such as diclofenac to be achieved before the patient perceives pain. Hence, we recommend that ropivacaine is a better alternative to the traditional lignocaine for use in IVRA.

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